Key Note

# Chapter 15: Changes in perception through the life-span

## Key note 15B: Hemispheric differences in categorical perception in infancy

Early studies of categorical perception of colour vision in infants suggested that the underlying process reflected properties of the visual system rather than of language. This note describes later work which suggests that language may have an influence on categorical perception in adults.

As noted in the book (Chapter 15), Franklin and Davies (2004) found evidence for categorical perception of colour in infants. Despite the apparent similarity between infant and adult categorical perception of colour, it turns out that there are important differences. Franklin et al. (2008) measured the time taken to initiate an eye movement to a target which could appear to the left or right of a fixation point. The target differed from the background by the same number of Munsell steps, whether it was from the same or from a different category. In adults, eye movement latency was shorter when the target was from a different category, an effect which was larger when the target fell in the right than in the left visual field. In infants (mean age 20.6weeks), the same difference between within- and between-category targets was found, but only when the target fell in the left visual field. For targets in the right visual field, no difference was found between within- and between-category targets. The authors conclude that categorical perception of colour is lateralised to the left hemisphere in adults, but to the right hemisphere in infants, and suggest that the development of left-hemisphere based language in adults imposes categories on the left hemisphere. The switch of hemispheric dominance in the effect does suggest a role for language in categorical perception of colour in adulthood. Perhaps language can be thought of as reinforcing hard-wired properties of the visual system, and producing an anatomical link between linguistic and visual processes.

When the experiment was repeated for orientation rather than colour categories, a different result was found (Franklin et al., 2010). The authors wished to use two categories, vertical and oblique, and in an initial experiment they established the category boundary between them. Short (7.5 deg long) single lines were presented one at a time in the centre of a computer monitor. Their orientation varied in 1 deg steps between vertical and a tilt of 30 deg from vertical (an orientation which would certainly be classified as oblique). At the same time, two similar reference lines, one vertical, one 30 deg from vertical were shown, one each side of the stimulus line. The task was to classify each stimulus line as more like the vertical or the oblique reference. The authors fitted a sigmoid (S-shaped) curve to their data, from which they could determine the orientation for which half the classifications were of vertical and half were of oblique (in their conditions 9.05 deg from vertical). They generated four stimulus lines for future experiments, two in the vertical category (tilts of 0.5 and 6 deg from vertical) and two in the oblique category (tilts of 11.5 and 17 deg from vertical). To produce a between-category change, they could present the lines with a 6 and a 11.5 deg tilt.

**Figure 1** Schematic representation of the type of display used by Franklin et al. (2010).

Adult participants fixated the centre of a computer screen and were presented with displays like that depicted in Figure 1 for 250 ms. The task was to decide on which side of the display one of the lines had a different orientation from the others. When the target fell in the left visual field, between category detection was significantly more accurate than either vertical or oblique within-category detection, whereas there was no significant difference between types of detection for targets in the right visual field. In a further experiment using similar displays, the time taken by infants (mean age 24.5 weeks) to initiate an eye movement to the target was measured. For targets in the right visual field, initiation times were significantly shorter for between- than for within-category targets, whereas the difference between the two types of target as not significant when they fell in the left visual field. [Note: the text in the journal article says that the difference between target types was significant for the left and not for the right visual field, but the first author confirms that this is the wrong way round, and that only in the right visual field was the difference significant.] Thus adults displayed categorical perception for orientation when stimuli fell in the left but not the right visual field, whereas infants showed the opposite pattern of results. In other words, categorical perception of orientation is lateralised in the right hemisphere in adults, but in the left hemisphere in infants, which is the opposite asymmetry from that found for colour. The authors conclude that categorization imposed by language cannot alone explain the lateralisation of categorical perception in adults (or of course in pre-linguistic infants), or why it should be different from that in infants. They speculate that language might somehow affect the underlying mechanisms or strategies of categorical processing indirectly, for example by compressing or expanding categories. However, the reason for this intriguing pattern of results is not yet clear.

Franklin A, Catherwood D, Alvarez J, Axelsson E (2010) Hemispheric asymmetries in categorical perception of orientation in infants. *Neuropsychologia* 48: 2648–2657.

Franklin A, Davies IRL (2004) New evidence for infant colour categories. *British Journal of Experimental Psychology* 22: 349–377.

Franklin A, Drivonikou GV, Bevis L, Davies IRL, Kay P, Regier T (2008) Categorical perception of color is lateralized to the right hemisphere in infants, but to the left hemisphere in adults. *Proceedings of the National Academy of Sciences* 105(9): 3221–3225.